INSTRUCTION MANUAL

AR252

**without
LCD display**

**with
LCD display**

HUMIDITY AND TEMPERATURE TRANSDUCER

$\boxtimes$ $C\epsilon$

Thank you for choosing our product.

This manual will facilitate proper operation, safe use and full utilization of this device.

Thoroughly read and understand this instruction manual before commencing installation and start-up.

Should you have any additional questions, feel free to contact our technical advisors.

SPIS TREŚCI

The manufacturer reserves the right to modify the device design and software without degrading technical parameters.

1. SAFETY RULES ⚠

■ **read this instruction manual thoroughly before commencing to use this device,**
■ before switching on the power supply, make sure that all cables are appropriately connected
  to avoid device damage,
■ ensure suitable operating conditions in line with the device specification (supply voltage,
  humidity, temperature)

2. INSTALLATION RECOMMENDATIONS ⚠

The device has been designed to ensure a suitable level of immunity to the majority of disturbances
that can occur in an industrial environment. In environments where the level of interference is unknown
it is recommended to use the following measures preventing the potential interference of instrument
operation:
■ do not supply the voltage from the same lines as high power devices without using appropriate
  network filters,
■ use screened supply and signal cables, screens should be earthed on one end only as close
  to the instrument as possible,
■ avoid laying supply and signal cables directly next to and in parallel to electrical power cables
  and supply cables,
■ it is recommended to twist signal cables in pairs,
■ avoid installing the instrument in proximity to remotely controlled devices, electromagnetic measuring
  instruments, high power loads, loads with phase or group power control and other devices generating
  impulse interference.

3 . GENERAL SPECIFICATION OF TRANSDUCER TYPE AR252

■ conversion of measured values to a proportional analogue signal 4..20mA, 0..10V or digital
  via the RS485/RS232 interface, MODBUS-RTU protocol (slave)
■ high quality air humidity and temperature sensor in a protective housing
■ temperature compensation of humidity measurement
■ long-term high stability of measurements*
■ calculation of dew/frost point[°C], absolute humidity [g/m3] (calculations for atmospheric pressure
  of 1013 hPa) with a feature enabling feeding calculated values via the analogue output
■ feature enabling programming of configuration parameters using an optional control panel
  or via the RS485/RS232 optical interface
■ programmable measuring ranges for humidity and temperature
■ IP65 industrial housing
■ ARSOFT-CFG software is available for devices with a digital output, it enables the configuration
  (free version available for download from www.apar.pl)
■ high accuracy and immunity to interference occurring in industrial environments
■ filter with a metal mesh for protecting the sensor against dust is available as an accessory
■ options:
  - LCD display with keyboard – control panel
 - probe on a stainless steel pipe

*it is advised that the instrument should be calibrated in accordance with the requirements in force in the place of installation or every 12 months

4. TECHNICAL DATA

Sensor..digital sensor by Sensirion
Sensor housing...ABS, gap width 1mm
Measuring range
  - humidity .... 0 ÷ 100 %RH
  - temperature... -30 ÷ 80 °C (standard)
Measuring accuracy
  - humidity .... ±3 %RH (20÷80 %RH, T=25°C)
                                                              ±3 ÷ 5 %RH (<20 i >80 %RH)
  - temperature... ±0,5°C (in range 20 ÷ 30°C)
                                                              ±0,5÷1,8°C (in remainder range)
Hysteresis..±1% RH
Long-term stability... <0,5% RH / year
Response time (63%)....................................10s (airflow > 1m/s)
Measurement period......................................1s
LCD display..4 digits, height 10 mm
Analogue output (without galvanic separation)
  - current .... 4 ÷ 20 mA
    - maximum resolution... 14,5 μA
    - current-carrying capacity..................................... Robc<(Uzas-12V)/22mA
  - voltage.. 0 ÷ 10V,
    - maximum resolution... 9,1 mV
    - current-carrying capacity..................................... Io < 4,5 mA
  - output intrinsic error......... ....<0,1 % of output range
Digital output (without galvanic separation)................. RS485/RS232, MODBUS-RTU transmission protocol,
  - character format.. 8N1 (8b data, 1 stop bit, without even parity bit)
  - transmission rate (bit/s)... 600, 1200, 2400, 4800, 9600, 19200, 38400
Output supply 4÷20 mA................................. 12 ÷ 36 V DC (supply in power loop)
  - load characteristics... Robc<(Uzas-12V)/22mA
0÷10 V output supply....................................... 18 ÷ 30 V DC
RS485/RS232 output supply...9 ÷ 28 V AC or 9 ÷ 36 V DC
Operation temperature range....................................... -30 ÷ 85 °C (without LCD display)
                                                              -20 ÷ 70 °C (with LCD display)
Operating environment... air and inert gases
Protection rating of the housing................................. IP65
Electromagnetic compatibility (EMC)
  - immunity: in acc. with PN-EN 61000-6-2:2002(U)
  - emissivity: in acc. with PN-EN 61000-6-4:2002(U)

5. HOUSING AND THE METHOD OF INSTALLATION

Material............................. polycarbonate
Housing dimensions.........58x64x35 mm
Mounting holes......…..........2 x ⌀4,3 mm (accessible after
                              the face cover is removed)
Hole spacing.......…............46x34 mm
Operating orientation........any (or with the sensor
                              housing towards ground
                              when the transducer
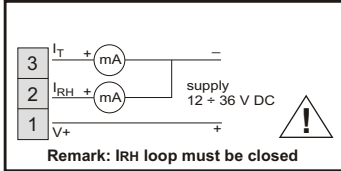   is at risk of direct water contact)
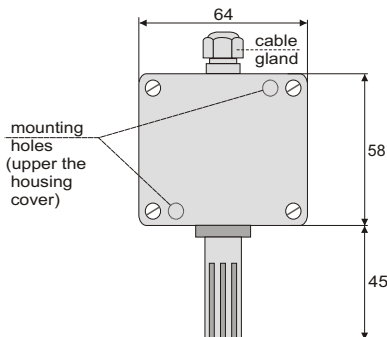
# 6. DESCRIPTION OF THE TERMINAL BLOCK AND ELECTRICAL CONNECTIONS

To access the terminals and make connections, do the following:
- remove 4 mounting screws and remove the housing cover,
- next – in the LCD display version - unscrew 2 mounting screws and lift the display plate,
- insert cables inside the housing through the cable gland.

a) 4..20mA current output model (AR252/J2)   b) 0..10V voltage output model (AR252/U3)

Remark: IRH loop must be closed
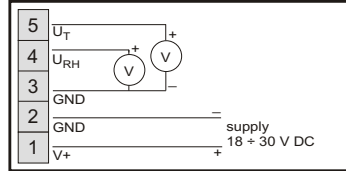
I_{RH} , U_{RH} - RH output – the output signal is proportional to the measured value 1 (humidity)
I_T , U_T - T output – the output signal is proportional to the measured value 2 (temperature)
V+   - supply **(in the case of AR252/J2 version the IRH loop must be closed)**
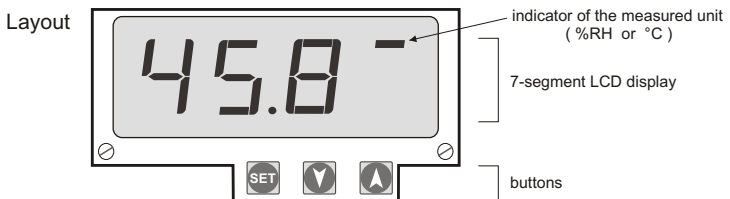GND   - system ground

c) RS485 or RS232 digital output model (AR252/R4 or AR2S2/R2)
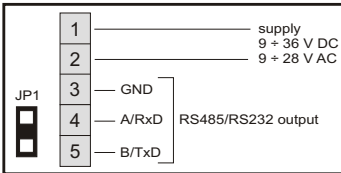
CAUTION : ⚠
To ensure IP65 protection rating,
the cable gland nut and
the housing cover must
be accurately tightened.

JP1 - jumper terminating the RS485 interface line with a 120Ω resistor (termination connected when JP1 short-circuited)

7. BUTTONS ON THE CONTROL PANEL AND THEIR FUNCTIONS

Layout

indicator of the measured unit (%RH or °C)

7-segment LCD display

buttons

There are 3 buttons on the control panel, their function is explained below:

[SET] - view parameter value (designated **SET** in this text)

[▲] or [▼] - move to the next/previous parameter (designated ▲ or ▼ in this text)

Available key combinations:
SET + ▼ or ▲   - increase/decrease parameter value
▼ + ▲   - **quick return to the measured value display (default mode)**
               - hold for more than 2 s – enter programming mode

8. PROGRAMMING CONFIGURATION PARAMETERS

■ press buttons ▼ and ▲ at the same time and hold until `ConF` message appears
■ using the device in configuration parameters programming mode:
  - the name of the parameter is displayed mnemonically (`dot`, `ch-1` – see Table 1 and 2),
  - press **SET**, the display will show the value of the parameter,
  - press ▲ to go to the next parameter, press ▼ to return to the previous parameter,
  - Press SET together with ▼ or ▲ to change the value of the current parameter,
  - press ▼ and ▲ at the same time (or wait about 1 min.) to exit configuration.

Table 1. **Configuration parameters for analogue 4..20mA or 0..10V output model**

NR	MNEM	Parameter description	Read parameter value - **SET**, Change parameter value - **SET + ▲** or ▼	Settings	
			Parameter value and change range	factory	user
1	dot	indication resolution	0=0, 1=0.0	1=0.0	
2	ch-1	1st displayed value (alternately with the 2nd value – parameter ch-2) and RH output signal	0=relative humidity [%RH]	0=%RH	
			1=temperature [°C]		
			2=absolute humidity [g/m3] **(1)**		
			3=dew/frost point [°C] **(1)**		
3	ch-2	2nd displayed value (alternately with the 1st value – parameter ch-1) and T output signal	0=relative humidity [%RH]	1=°C	
			1=temperature [°C]		
			2=absolute humidity [g/m3] **(1)**		
			3=dew/frost point [°C] **(1)**		
4	dPEr	interval of switching displayed values **(2)**	1.0÷10.0 s	4.0 s	
5	Hilo	low value of the RH output measuring range	-50.0 ÷ 100.0 (the unit depends on the setting of parameter 2: ch-1)	0.0 [%RH]	
6	HiHi	high value of the RH output measuring range	-50.0 ÷ 100.0 (the unit depends on the setting of parameter 2: ch-1)	100.0 [%RH]	
7	t2Lo	low value of the T output measuring range	-50.0 ÷ 100.0 (the unit depends on the setting of parameter 3: ch-2)	-30.0 [°C]	
8	t2Hi	high value of the T output measuring range	-50.0 ÷ 100.0 (the unit depends on the setting of parameter 3: ch-2)	80.0 [°C]	
9	coH1	zero offset for RH output (humidity) **(3)**	-20.0 ÷ 20.0 (the unit depends on the setting of parameter 2: ch-1)	0.0 [%RH]	
10	cGH1	amplification for RH output (humidity) **(3)**	15.0 ÷ 15.0 (the unit depends on the setting of parameter 2: ch-1)	0.0 [%RH]	
11	cot2	zero offset for T output (temperature) **(3)**	-20.0 ÷ 20.0 (the unit depends on the setting of parameter 3: ch-2)	0.0 [°C]	
12	cGt2	amplification for T output (temperature) **(3)**	15.0 ÷ 15.0 (the unit depends on the setting of parameter 3: ch-2)	0.0 [°C]	

Table 2. **Configuration parameters for digital RS485 or RS232 model**

Change parameter name - ▲ or ▼			Read parameter value - **SET**, Change parameter value - **SET + ▲ or ▼**	Settings	
NR	MNEM	Parameter description	Parameter value and change range	factory	user
0	dot	indication resolution	0=0, 1=00	1=00	
1	ch-1	1st displayed value (alternately with the 2nd value – parameter ch-2) and RH output signal	0=relative humidity [%RH] 1=temperature [°C] 2=absolute humidity [g/m3] **(1)** 3=dew/frost point [°C] **(1)**	0=%RH	
2	ch-2	2nd displayed value (alternately with the 1st value – parameter ch-1) and T output signal	0=relative humidity [%RH] 1=temperature [°C] 2=absolute humidity [g/m3] **(1)** 3=dew/frost point [°C] **(1)**	1=°C	
3	dPEr	interval of switching displayed values **(2)**	10÷100 s	40 s	
4	coHu	zero offset for humidity **(3)**	-200 ÷ 200 [%RH]	0.0	
5	cGHu	amplification for humidity **(3)**	150 ÷ 150 % [%RH]	0.0	
6	cotE	zero offset for temperature **(3)**	-200 ÷ 200 [°C]	0.0	
7	cGtE	amplification for temperature **(3)**	150 ÷ 150 % [°C]	0.0	
8	Addr	device MODBUS address	1÷247	1	
9	br	transmission rate [bps]	0=600, 1=1200, 2=2400, 3=4800, 4=9600, 5=14400, 6=19200, 7=38400	5	

Remarks:

(1) - values calculated based on the measurement of relative humidity %RH and temperature °C for atmospheric pressure P=1013 hPa,

(2) - to display only one type of value, the following condition must be met: ch-1 = ch-2,

(3) - parameters enabling the adjustment of zero and sensitivity for %RH and °C measurements
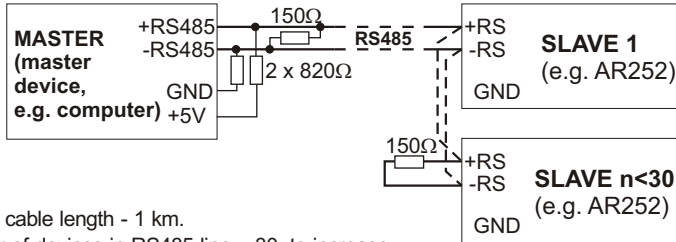
9. LIST OF MESSAGES

◼◼◼ ...top display segments – high measurement range exceeded
▬▬▬ ...bottom display segments – low measurement range exceeded
ConF ...enter parameter configuration mode
---- ...no communication with the sensor (sensor damaged or broken electrical connections)

10. RS485 COMMUNICATION INTERFACE (as per EIA RS-485).

Maximum RS485 cable length - 1 km.
Maximum number of devices in RS485 line – 30, to increase
the number of devices, use RS485/RS485 amplifiers.
Terminating resistors when MASTER at the beginning of the line (fig. above):
- the beginning of the line   - 2 x 820Ω to ground and +5V MASTER and 150Ω between the lines,
- the end of the line   - 150Ω between the lines (or jumper JP1 short-circuited, see Chapter 6).
Terminating resistors when MASTER is in the middle of the line:
- by the converter   - 2 x 820Ω, to ground and +5V converter,
- on both ends of the line   - 150Ω each between the lines (or jumpers JP1 short-circuited, see Chapter 6)

11. RS232C COMMUNICATION INTERFACE (as per EIA RS-232C).
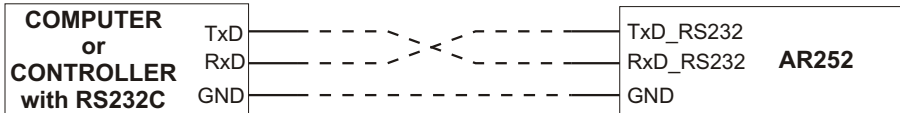
Maximum cable length - 10 m.
Maximum number of devices connected to the computer - 1.

12. MODBUS - RTU SERIAL TRANSMISSION PROTOCOL.

Character format : 8 bits, 1 stop bit, without even parity bit,
Available functions : **READ** - 0x03, 0x04, **WRITE** - 0x06, max. repetition frequency: **2Hz**

Table 3. Registry map for MODBUS-RTU protocol (numerical values in decimal form)

Registry address	Description	Function
0	measured relative humidity: 0...100.0 [%RH]	READ
1	measured temperature: -30.0...80.0 [°C]	READ
2	calculated absolute humidity : 0...99.9 [g/m^3]	READ
3	calculated dew/frost point : -30.0...80.0 [°C]	READ
4...13	read/write parameter (**dot**, **ch- 1**, ...) registry address = number from Table 2 (rozdział 8) **+ 4**	READ / WRITE
200 (remark 1)	device identifier : 252 - AR252	READ

Uwagi:

1 - when using ARSOFT-WZ1 (free application for configuring APAR devices via serial interface, available from www.apar.pl/pobierz/oprogramowanie), set this value in "Program options" window in the field named "Device type identifier registry address"

Request frame format for READ function (frame length - 8 Bytes):
1B (device address) - **1B** (function = 0x04) - **2B** (registry address to read - High Byte, Low Byte) - **2B** (number of registers to read 14) - **2B** (checksum LBCRC-HBCRC)
Example (relative humidity readout, parameter 9- **Addr** = **1**) : 0x01 - 0x04 - 0x0000 - 0x0001 - 0x31CA

Request frame format for WRITE function (frame length - 8 Bytes):
1B (device address) - **1B** (function = 0x06) - **2B** (registry address to write - HB, LB) - **2B** (registry value to write - HB, LB) - **2B** (checksum LBCRC-HBCRC)
Example (write 0 parameter: **dot** value 0 : **0.0**) : 0x01 - 0x06 - 0x0004 - 0x0000 - 0xC80B

Response frame format for READ function (frame length - 7 Bytes):
1B (device address) - **1B** (function = 0x04) - **1B** (the number of bytes in the data field is always 2)
2B (registry value HB-LB) - **2B** (checksum LCRC-HCRC)
Example (parameter value = 0) : 0x01 - 0x04 - 0x02 - 0x0000 - 0xB930

Response frame format for WRITE function (frame length - 8 Bytes): request frame copy

Errors (special response: function field = 0x83, 0x84 when function READ or 0x86 when function WRITE, High Byte in data field = 0):

- 1 = null parameter address,
- 2 = wrong parameter value to write
- 3 = wrong function number

Example (null parameter address to read): 0x01 - 0x84 - 0x02 - 0x0001 - 0x5130

13. IMPORTANT REMARKS ON USE – using arc-suppression systems.

If inductive load (e.g. contactor coil, transformer) is connected to the transmitter contacts, when they are being opened, over-voltage and an electric arc are present and are caused by the discharge of energy accumulated in the inductance. Especially negative effects of over-voltage include: shortened life of contacts and transmitters, damage to semiconductors (diodes, thyristors and triacs), damage to or failure of control and measuring systems, emission of the electromagnetic field causing interference with local devices. To avoid these effects, over-voltages must be decreased to a safe level. The simplest method consists in the connection of an appropriate arc-suppression module directly to the inductive load terminals. In general, an appropriate arc-suppression system should be selected for each type of inductive load. State-of-the-art contactors are usually fitted with suitable factory arc-suppression systems. If they are absent, purchase a contactor with integrated arc-suppression system. Temporarily, the load can be shunted with an RC circuit, e.g. R=47Ω/1W and C=22nF/630V.

Connect the arc-suppression system to the inductive load contacts.
The use of the arc-suppression system limits the burning of transmitter contacts in the controller and limits the probability of them sticking together.
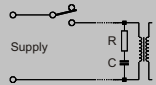
14. NOTES.

Calibration Certification – **SHT1x / SHT2x / SHT7x Series**

SENSIRION
THE SENSOR COMPANY

Calibration Certification

Product: SHT1x / SHT2x / SHT7x Series

Description: Digital Humidity and Temperature Sensors

The above mentioned products are calibrated to meet the specifications according to the corresponding Sensirion data sheet. Each device is individually tested after its calibration.

Sensirion uses transfer standards for the calibration. These transfer standards are themselves subject to a scheduled calibration procedure. The calibration of the reference itself used for the calibration of the transfer standards is performed by an ISO/IEC 17025 accredited laboratory.

The accreditation body is full member of the International Laboratory Accreditation Cooperation (www.ilac.org). Calibration certificates issued by facilities accredited by a signatory to the ILAC Mutual Recognition Arrangement (MRA) are accepted by all signatories to the ILAC MRA.

This provides traceability of measurement to recognized national standards and to units of measurement realized at the "National Physical Laboratory" (NPL) or other recognized national standards laboratories like "Physikalisch-Technische Bundesanstalt" (PTB) or "National Institute of Standards and Technology" (NIST).

Staefa, August 2010

Dr. Felix Mayer   Andreas Kaatz
Co-CEO, Sensirion AG   Quality Manager, Sensirion AG